PEOPLE AT WORK

Keeping an eye on the Earth

By Ann Hutchison

NASA JSC Photo JSC2000-01176 by Benny Benavides

JSC Office of Earth Science team members receive JSC Group Achievement Awards in recognition of their outstanding contributions toward astronaut candidate training in Earth Sciences. Recipients, from left, are: Robert Payne (Lockheed Martin), Kimberly Willis (Lockheed Martin), Susan Runco (NASA), Dr. Julie Robinson (Lockheed Martin), Dr. Justin Wilkinson (Lockheed Martin), Dr. Kamlesh Lulla (NASA), Dr. Cynthia Evans (Lockheed Martin), and Joe Caruana (Lockheed Martin). Not pictured: Dr. Pat Dickerson (Lockheed Martin).

Tucked away on the second floor of Building 31, JSC's Office of Earth Sciences goes quietly about its work of studying the Earth from outer space.

For nearly 40 years, since the Mercury missions began America's human space program, astronauts have photographed the Earth below. "For many years, astronaut photography of the Earth with hand-held cameras has provided scientists around the world with a valuable tool to study our planet," said Dr. Kamlesh P. Lulla, chief of the OES. "These photos are important in documenting changes in the Earth's atmosphere, monitoring environmental changes and providing updated data for mapping the Earth's surface."

The Earth observation photographs taken by astronauts also complement data from meteorological and other satellites. And the Earth observation effort over a period of many years "facilitates the detection of various changes, such as coastal shoreline and lake levels, on the Earth's surface," Lulla said. They also contribute to our understanding of how events such as volcanic eruptions, El Niño and other natural phenomena impact the planet.

The Office of Earth Sciences is part of the Earth Science and Solar System Exploration Division in the Space and Life Sciences Directorate. With a small but active staff of civil servants and Lockheed Martin contractor employees, the office carries out an ambitious, multifaceted program in support of NASA's Earth sciences effort. The office's scientists, who support the Human Exploration and Development of Space program, represent expertise in a wide array of areas, including remote sensing, geology, Earth sciences, ocean and weather phenomena, planetary geology and ecology.

Lulla's office has three primary functions: training astronauts and astronaut candidates (ASCANs), supporting space shuttle and International Space Station science operations, and public education and outreach. Every ASCAN is trained in scientific observation of geological, oceanographic, environmental and meteorological phenomena, as well as in the use of photographic equipment and techniques.

"Our objective is to make the astronauts Earth-smart," Lulla said. "ASCANs come from very diverse backgrounds," he explained, "so our goal is to give everyone the same level of knowledge."

In addition to classroom instruction in a variety of Earth sciences disciplines, the training includes two field trips during which ASCANs get hands-on experience. "Field trips offer an integrated view of how geological history, climate and human presence have impacted the Earth," Lulla noted.

ASCANs get hands-on experience during a 1-day visit to the Galveston Bay area.

The first field trip is a 1-day visit to the Galveston Bay area, during which groups of 8 to 10 ASCANs get to see for themselves the interactions between various Earth processes and human activities. Later, they journey to New Mexico for a 3 1/2 -to 4-day trip to observe the processes that have created these landscapes. They also receive training in exploration techniques to prepare them for possible future missions to the moon or Mars. Once astronauts are assigned to particular missions, the OES provides training in mission-specific payloads and equipment. Well-trained astronauts contribute much to the program's success, Lulla said, by making informed, real-time decisions about which areas and phenomena to photograph.

JSC's Earth scientists also support science operations during and after shuttle missions. During a mission, an Earth sciences expert identifies "targets of opportunity" for hand-held camera photography. Using a map of the Earth and a ground track chart, scientists pinpoint either features of interest (such as lakes or mountain ranges) or natural or human-induced activities (hurricanes or oil fires, for example). A list of these targets is uplinked to the crew each day of the mission as part of the execute package. Lulla said crewmembers do as much photography as they can fit into their schedule, although Earth observation photography is not part of the crew's timelined activities.

After the mission, the scientists and crewmembers get together to review the successes and issues that occurred during the mission. This also gives the crew an opportunity to view the photos taken during the mission. The images from each flight are cataloged and archived, and some are put into an on-line database accessible to anyone with Internet access (http://eol.jsc.nasa.gov). Lulla said that more than 95,000 people from 63 countries log on to this site each month.

OES's database now includes more than 400,000 images, most of them taken by space shuttle astronauts since the program began in 1981. Astronauts and cosmonauts on the Russian Space Station Mir took an additional 22,000 photographs during flights between March 1996 and June 1998. These long-duration flights also allowed the development of refinements in the study of phenomena such as forest fires, dust storms, floods and the impact of El Niño in 1997/98. In addition, photography of the Earth from space helped scientists further develop tools and approaches for Earth science operations on the ISS, while also providing insights into such areas as window quality and the use of various types of film on orbit.

With construction of the ISS now underway, OES is preparing for a new era in Earth observation. While continuing to train crewmembers assigned to fly on the space station, the office has assumed a new role: coordinating the science and applications research from the Window Observational Research Facility. Located in the U.S. Laboratory Module, the 20.3-inch-diameter WORF will be perpendicular to the Earth's surface most of the time to facilitate observation of the Earth below. It also will be the highest optical-quality window ever flown on an inhabited spacecraft.

The WORF will provide a stable platform for a variety of Earth science studies and it will support both remotely controlled research and hand-held photography by the ISS crew. A rack system installed around the window will provide attachment points, power and data transfer capability for cameras, scanners and other instruments to be mounted in the window. The racks, which are designed to allow rapid changes of equipment by the crew, also will allow multiple instruments to be mounted at the same time.

"The ISS will be especially well-suited for Earth observations," Lulla noted. It will cover most of the world's coastlines and heavily populated areas.

The OES also has a third focus: public education and outreach. According to Lulla, the American public supports NASA's Earth observation studies, as evidenced by a 1998 *Space News* poll that reported that 92 percent of American taxpayers want NASA to monitor Earth's environment from space. Because this research is of such interest to so many people, "We are committed to getting vital Earth observation science information into the public domain," Lulla said. An increasingly popular way of disseminating information and images is over the Internet. In addition to the site listed above, images and information also are available at the following sites:

http://earth.jsc.nasa.gov

http://nix.nasa.gov

Working with classroom educators is another way of spreading the word about the importance of Earth observations. Lulla and other scientists work each summer with teachers who visit JSC as part of their continuing education and enrichment programs. One of the most successful ventures to date occurred in the fall of 1998, after Lulla spent four hours talking about NASA Earth sciences to a group of teachers from Oklahoma. Not only did the teachers design lesson plans that incorporated what they had learned at JSC, but they also persuaded the local newspaper to produce an insert for the Sunday paper devoted solely to NASA's astronaut Earth photography. That insert, which included articles, photographs and references, reached some 40,000 homes.

"Just think of the return we got on our investment of just four hours of our time," Lulla said. "Many teachers use only 5 percent or 10 percent of what they learn here, but the Oklahoma teachers did an outstanding job of spreading the word about astronaut Earth photography, and in the process reached thousands of students."

"We consider these astronaut photographs of the Earth to be a national treasure," Lulla continued. "But we also realize the importance of making these images available to scientists, educators and to the interested public. They provide important new insights into how nature and humans are changing planet Earth."

In April, the OES will take another step toward making public more astronaut photographs of Earth, when John Wiley & Sons, a major publisher of science and engineering books, plans to publish a collection of more than 110 astronaut Earth photographs and articles summarizing the results from imagery analysis. Astronauts and cosmonauts on Mir took the color and black-and-white photographs between March 1996 and June 1998. The book – *Dynamic Earth Environments: New Observations from Shuttle-Mir Missions* – was edited by Lulla and Lev Desinov, Ph.D., of the Institute of Geography of the Russian Academy of Sciences in Moscow. Associate editors were Drs. Cindy Evans, Julie Robinson and Pat Dickerson, senior scientists in the OES.

The continuing contributions of the OES were acknowledged recently when the office was honored with a Group Achievement Award for "outstanding contributions toward Astronaut Candidate training in Earth Sciences." Additionally, individual members receiving recognition included Lulla, Evans, Robinson, Dickerson, Susan Runco, Dr. Justin Wilkinson, Kim Willis and Joe Caruana. ■